**Mangrove associated fish species diversity along Sikka coast, Gulf of Kachchh, Gujarat, India**

**Abstract**

The present study was conducted on the fish diversity along the Sikka coast, Gulf of Kachchh, Gujarat, focusing on two sampling sites: the DCC (Digvijay Cement Company) jetty area and the GSFC (Gujarat State Fertilizer and Chemicals Limited) jetty area, during the period from October 2020 to March 2021. A total of six species from three orders Gobiiformes, Blenniformes, and Mugiliformes representing four families (Gobiidae, Oxudercidae, Blenniidae, and Mugilidae) were documented. Acentrogobius dayi and Mugil cephalus were observed at both sites, while Amblygobius albimaculatus, Trypauchen vagina, and Omobranchus punctatus were exclusive to the GSFC jetty area. Blenniella periophthalamus was present at both sites, indicating broader habitat adaptability. The distribution patterns revealed site-specific preferences, likely influenced by ecological factors such as substrate composition, salinity variations, and anthropogenic activities. Notably, the absence of mangrove-associated species like Trypauchen vagina at the DCC jetty area highlights potential differences in habitat suitability.

**Keyword:** GSFC jetty, Gobiidae, Blenniformes and Gulf of Kachchh

**1. Introduction**

India is endowed with a rich diversity of water resources that support a thriving fisheries sector, bolstered by a coastline spanning 8,118 km, of which Gujarat accounts for approximately 1,600 km (FAO, 2008). The Gulf of Kachchh, with its extensive intertidal mudflats, mangroves, and rich rocky coral reefs, serves as a critical breeding ground for numerous marine organisms. The World Conservation Strategy emphasizes the ecological importance of these habitats (Parmar et al., 2015).

Mangroves, salt-tolerant plants found within the intertidal zones of tropical and subtropical estuarine regions, are vital to coastal ecosystems. They play a significant role in protecting shorelines from erosion and providing resources for forestry, fisheries, food, agriculture, and medicinal industries (Venkatesan et al., 2010). These highly productive ecosystems act as a buffer between land and sea (Kathiresan and Rajendran, 2005) while also maintaining water quality, filtering suspended materials, and recycling nutrients (Bandaranayake et al., 2002). Mangroves offer feeding, reproductive, shelter, and nursery sites to numerous terrestrial and aquatic species (Kathiresan and Rajendran, 2005; Jatav et al., 2022).

The Gulf of Kachchh is renowned for its floral and faunal diversity, encompassing unique habitats such as coral reefs, mangroves, sandy shores, rocky shores, and mudflats (Trivedi et al., 2012; Jatav et al., 2023). India’s mangrove ecosystems are home to 3,111 associated faunal species, including prawns, crabs, mollusks, fishes, reptiles, amphibians, birds, and mammals (Kathiresan and Quasim, 2005). Globally, fishes represent nearly half of all vertebrate species, with approximately 36,305 valid species identified—18,380 in freshwater and the rest in marine environments (Fricke et al., 2022). Global surveys suggest that at least 5,000 additional fish species are yet to be discovered (Sarkar et al., 2012). India is home to 3,231 fish species, representing 9.7% of the world's total, with marine fish comprising 76% of India’s ichthyofaunal diversity. Marine species alone include 2,492 species from 941 genera, spread across 240 families and 40 orders (Gopi and Mishra, 2015).

The Gulf of Kachchh hosts approximately 1,500 coastal and marine species, with fish and birds forming major contributions to its biodiversity. Other notable taxa include Annelida, Arthropoda, Bryozoa, Echinodermata, Mollusca, and Porifera. The waters off Gujarat's coast have reported approximately 486 fish species, underscoring the region’s ecological significance (Katira and Kardani, 2017; Subba Rao and Sastry, 2005; Parmar et al., 2022). This research aims to document fish diversity along the Sikka coast, Gulf of Kachchh, Gujarat, focusing on species composition, distribution patterns, and habitat preferences. It seeks to explore ecological factors influencing diversity to support conservation and sustainable management of the region's coastal ecosystems.

**2. Material and methods**

The present study was conducted on the fish diversity along the Sikka coast, Gulf of Kachchh, Gujarat, focusing on two sampling sites: the DCC (Digvijay Cement Company) jetty area (22° 26′ 00.6″N, 69° 49′ 27.4″E) and the GSFC (Gujarat State Fertilizer and Chemicals Limited) jetty area (22° 26′ 47.9″N, 69° 49′ 43.8″E). The study was conducted during the period from October 2020 to March 2021. Field sampling was carried out during low tide as per the tidal schedule. Fish samples were collected from the intertidal zone using various fishing gears to maximize species diversity. These included gill nets, traps, and pots, supplemented with purchases from local fishers. The gill nets used had a small mesh size of 1 mm x 1 mm, which was effective in retaining smaller fish species. Fishing activities were conducted during the early morning and evening hours. In the field, fish specimens were labelled and stored in ice boxes for further examination. The species were identified using the methods outlined by Randall (1995) and verified with the help of standard identification guides, including those by Froese and Pauly (2022). The samples were also photographed to support identification and documentation.



**Fig. 1 Sikka coast Gulf of Kachchh, Gujarat, India**

**3. Result and discussion**

This study examined the fish diversity along the Sikka coast in the Gulf of Kachchh, Gujarat, focusing on two sampling locations: the DCC (Digvijay Cement Company) jetty and the GSFC (Gujarat State Fertilizer and Chemicals Limited) jetty, during the period from October 2020 to March 2021. A total of six fish species were identified across three orders (Gobiiformes 50%, Blenniformes 33%, and Mugiliformes 17%, **Fig. 3.c**), four families (Gobiidae 33%, Oxudercidae 17%, Blenniidae 33%, and Mugilidae 17%, **Fig. 3.d**), and six genera (**Table- 1**). In the order Gobiiformes, *Acentrogobius dayi* was found at both sites, while *Amblygobius albimaculatus* and *Trypauchen vagina* were exclusive to the GSFC site. The Blenniformes order included *Blenniella periophthalamus*, present at both locations, whereas *Omobranchus punctatus* was only found at the GSFC site. The species *Mugil cephalus*, belonging to the order Mugiliformes, was observed at both sampling sites. These distributions suggest that ecological factors such as substrate composition, salinity, and human activities significantly influence species presence. For instance, *Trypauchen vagina*, which is typically associated with mangrove habitats, was absent at the DCC site, likely due to unsuitable habitat conditions.

The relatively low fish diversity recorded in this study may indicate unique ecological conditions within the Sikka mangrove ecosystem. This contrasts sharply with other mangrove habitats; for example, in the Ujung Kulon National Park in Indonesia 43 fish species from 33 genera and 24 families were reported (Wahyudewantoro, 2009), while in the Guimaras in the Philippines 50 species were documented with dominant vegetation of *Avicennia marina* (Abrogueña et al., 2012). The reduced diversity along the Sikka coast could be linked to environmental limitations, reduced mangrove cover, and anthropogenic impacts. As seen in other mangrove ecosystems, certain species dominated at each sampling site. This observation aligns with Nip and Wong (2010), who noted that mangrove fish communities often consist of a few dominant species despite high individual abundance. A similar pattern was reported in Sikao Creek, Thailand, where only 19 species were dominant among 455 individuals (Zagars et al., 2013), and in the Egyptian Red Sea mangroves, which supported 21 species represented by a total of 269 juvenile fish (El-Regal and Ibrahim, 2014).

The collected fish ranged from juvenile to adult stages, underscoring the critical role of mangrove habitats as feeding and nursery grounds. Previous research indicates that mangroves are vital for juvenile fish populations, with studies showing that 70%-90% of juvenile fish are found within these habitats (MacDonald et al., 2009; Mwandiya et al., 2009). Nip and Wong (2010) further emphasized this role by noting that nearly half of the fish caught in Hong Kong's mangrove waters were juveniles. The findings highlight the significance of mangrove ecosystems in supporting fish diversity and sustaining juvenile populations. However, the lower diversity observed in the Gulf of Kachchh compared to other mangrove ecosystems suggests a need for further investigation into environmental factors and human influences affecting species distribution. Future studies should focus on habitat characteristics such as substrate type, salinity gradients, and anthropogenic activities to inform effective conservation and management strategies. Protecting and restoring mangrove habitats along the Sikka coast is essential for ensuring the long-term sustainability of these ecosystems and their associated fish communities.

**3.1 Description of fish species based on various morphological and meristic traits**

**1. *Mugil cephalus* Linnaeus, 1758**

Mugil cephalus, commonly known as the flathead grey mullet, is a species found in diverse habitats such as mangroves, shallow water creeks, estuaries, and rivers. Taxonomically, it belongs to the kingdom Animalia, phylum Chordata, class Actinopterygii, order Mugiliformes, family Mugilidae, and genus Mugil. This fish is characterized by a first dorsal fin with four spines and a second dorsal fin with 8–9 soft rays. Its pectoral fin consists of 16–19 rays, the pelvic fin features one spine and five rays, and the anal fin has three spines with nine rays. The dorsal side of the mullet is typically black or blue, while the lateral and ventral sides are silvery or white, often with six to seven distinctive horizontal lateral stripes. The species has thin lips, lacks a lateral line, and possesses well-developed adipose eyelids that cover most of the pupil. Fin formula: D1. IV; D2. 8–9; P1. 16–19; P2. I/5; A. III/9.

**2. *Blenniella periophthalmus* (Valenciennes, 1836)**

Blenniella periophthalmus, commonly referred to as the blue-dashed rockskipper, inhabits mangroves, shallow water creeks, estuaries, and rivers. Taxonomically, it belongs to the kingdom Animalia, phylum Chordata, class Actinopterygii, order Blenniiformes, family Blenniidae, and genus Blenniella. This species is characterized by a dorsal fin with 12–13 spines and 19–20 rays, while the pectoral fin has 14–15 rays, and the anal fin comprises two spines and 20–26 rays. A small notch separates the spinous and rayed portions of the dorsal fin. Distinctive black spots cover its body, accompanied by black vertical bars originating from the base of the second dorsal fin. Fin formula: D. XII–XIII/19–20; P1. 14 -15; P2.; A. II/20–26.

**3. *Omobranchus punctatus* (Valenciennes, 1836)**

Omobranchus punctatus, commonly known as the muzzled blenny, is a species found in mangroves, shallow water creeks, estuaries, and rivers. It is classified under the kingdom Animalia, phylum Chordata, class Actinopterygii, order Blenniformes, family Blenniidae, and genus Omobranchus. The dorsal fin features 11–13 spines and 19–20 rays, while the pectoral fin has 16–17 rays, and the anal fin comprises two spines and 20–26 rays. Unique characteristics include a balloon-shaped mouth and operculum, as well as a pair of barbell-like structures located ventrally beneath the pectoral fin base. The jaws and snout resemble a parrot-like beak, and the contralateral pelvic fins are fused together. Fin formula: D. XI–XIII/19–20; P1. 16–17; P2.; A. II/20–26.

**4. *Acentrogobius dayi* Koumans, 1941**

Day’s Gobi (Acentrogobius dayi) is a species commonly found in mangroves, shallow water creeks, estuaries, and rivers. It belongs to the kingdom Animalia, phylum Chordata, class Actinopterygii, order Gobiiformes, family Gobiidae, and genus Acentrogobius. The first dorsal fin has seven spines, while the second dorsal fin contains 16–17 rays. The pectoral fins feature 15–16 rays, the pelvic fins have 9–10 rays, and the anal fin consists of 12–13 rays. Notable features include a black spot on the caudal peduncle, blue spots on the operculum, and one ray of the pectoral fin extended into a filament. Additionally, small canine teeth are present in the lower jaw. Fin formula: D. VII/10; P1.; P2.; A. I/9.

**5. *Amblygobius albimaculatus* (Rüppell, 1830)**

Butterfly Gobi (Amblygobius albimaculatus) is a species found in mangroves, shallow water creeks, estuaries, and rivers. It belongs to the kingdom Animalia, phylum Chordata, class Actinopterygii, order Perciformes, family Gobiidae, and genus Amblygobius. The first dorsal fin comprises six spines, while the second dorsal fin has 17 rays. The pectoral fin contains 16-17 rays, the pelvic fin features 14-15 rays, and the anal fin has 15 rays. Distinctive markings include six brown vertical bars along the body, a dark spot on the operculum above the pectoral fin base, and irregular blue bands on the cheeks and operculum. Additionally, the contralateral pelvic fins are fused to form a single structure. Fin formula: D. VII/13-15; P1.; P2.; A. I/12-14

**6. *Trypauchen vagina* (Bloch and Schneider, 1801)**

Trypauchen vagina, commonly known as the Burrowing Gobi, is a species found in mangroves, shallow water creeks, estuaries, and rivers. Taxonomically, it belongs to the kingdom Animalia, phylum Chordata, class Actinopterygii, order Gobiiformes, family Oxudercidae, and genus Trypauchen. The fish has an elongated body with a reddish-pink coloration and is characterized by distinctive pouches located on the upper edges of its gill covers. It inhabits burrows in silty and muddy substrates in both marine and brackish environments. Adaptations such as reduced eyes, which are completely covered with skin, and thickened flesh protecting the anterior portion of its head, enable the fish to efficiently dig and reside in its burrows. Fin formula D. XI/40-49; P1. 15; P2. 1/5; A. 40-46

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| **Fig. 2 a. Site wise comparison of mangrove associated fish diversity along Sikka coast**  **b. Monthly comparison of mangrove associated fish diversity along Sikka coast** | |
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| **Fig. 3 c. Order wise comparison of mangrove associated fish diversity along Sikka coast**  **d. Family wise comparison of mangrove associated fish diversity along Sikka coast** | |

**Table 1. Mangrove associated fish species of Sikka coast, Gulf of Kachchh**

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| **S. No.** | **Order** | **Family** | **Mangrove associated Fish species** | **IUCN status** | **Fin formula** |
|  | **Blenniformes** | **Blenniidae** | ***Omobranchus punctatus* (Valenciennes, 1836)** | **LC** | D. XI–XIII/19-20; P1. 16-17; P2.; A. II/20–26. |
|  | **Blenniformes** | **Blenniidae** | ***Blenniella periophthalmus* (Valenciennes, 1836)** | **LC** | D. XII–XIII/19–20; P1. 14-15; P2.; A. II/20–26. |
|  | **Gobiiformes** | **Gobiidae** | ***Acentrogobius dayi* Koumans, 1941** | **LC** | D. VII/10; P1.; P2.; A. I/9. |
|  | **Gobiiformes** | **Gobiidae** | ***Amblygobius albimaculatus* (Rüppell, 1830)** | **LC** | D. VII/13-15; P1.; P2.; A. I/12-14 |
|  | **Gobiiformes** | **Oxudercidae** | ***Trypauchen vagina (Bloch and Schneider, 1801)*** | **LC** | D. XI/40-49; P1. 15; P2. 1/5; A. 40-46 |
|  | **Mugiliformes** | **Mugilidae** | ***Mugil cephalus* Linnaeus, 1758** | **LC** | D1. IV; D2. 8–9; P1. 16-19; P2. I/5; A. III/9. |

**4. Conclusion**

The present examination of fish diversity within the mangrove ecosystems of the Sikka Coast in the Gulf of Kachchh, Gujarat, emphasizing the ecological significance of these habitats as essential feeding and nursery grounds for a variety of fish species. Six fish species was identified herein, distributed across three orders and four families, revealing site-specific variations in species distribution that are influenced by ecological factors such as substrate type, salinity gradients, industrial effluent and human activities. Furthermore, the predominance of juvenile fish underscores the critical role of mangroves in providing essential food and shelter, facilitating the survival and growth of early life stages. This study not only reinforces ecological value of mangrove habitats but also underscores the urgent need for conservation and sustainable management practices. Safeguarding these ecosystems is essential for the conservation of biodiversity and the sustenance of their ecological functions, which encompass supporting fisheries, bolstering coastal protection, and aiding in carbon sequestration.

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